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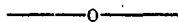
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## THE MEANS OF APPLYING POWER OR PRESSURE TO PRODUCE VENTILATION.

BY J. L. MORRIS.

We have seen that pressure is constantly a pressure of nearly a ton to the square foot in every direction in the air near the surface of the earth, owing to the weight of air above it; and we must either increase or lessen the amount of this pressure, in order to put the air into motion; and it is only the amount of this increase or decrease this ventilating pressure. There and not the entire pressure, that

We have next to consider the means employed to give rise to this ventilating pressure. There and not the entire pressure, that

puts the air into motion and overcomes the friction in mines.

Take the case of two shafts, of equal depth and having their tops and bottoms on the same level and filled with stagnant air, which likewise occupied on an opening, extending from the bottom of one shaft to the bottom of the other, and suppose that in the first place the weight of the air in one shaft is the same as that in the other, the temperature and other conditions being the same in each, and that the shafts are of the same sectional area or size, in this state the two columns of air exactly counter-balance and support each other, so that there is no motion in the air, and therefore no ventilation is produced; and further, if one shaft be ever so much larger than the other, the air it contains can only press upon that in the smaller one over the area of the smaller section; the air contained in the extra size of the larger shaft resting or pressing upon the sides of the shaft or airway at the place where the area is lessened, and not upon the air in the smaller shaft, so that whatever may be the relative sizes of the shafts, the air in the one will balance that in the other, if the density of the air is the same in each. If, however, by means of a furnace at or near the bottom of one of these shafts, the air in one shaft is heated and expanded, it becomes lighter, bulk for bulk, than the cool air in the other, and no longer balances it; the pressure of the heavier air then overcomes that of the lighter air and pushes it up the shaft before it, while the cool air from the shaft takes its place, but not in a cool state, as it gets heated in its turn in passing over the furnace, so

that there is a continued current of cool air going down one shaft which pushes before it a constant current of hot air up the other shaft.

In mines, the air instead of being allowed to go direct from the bottom of one shaft to the furnace and up the other, is guided by means of stoppings and doors into and along the various passages forming the workings of the mine, before it is brought upon the furnace or into the up cast shaft, and by this means, a continuous stream of air is made to sweep through workings and mix with and carry off the gasses as they are given off, and this we call the ventilation of the mines.

In some cases, men, boys and horses are required to travel in directions the air is not wanted to go, and in such cases we cannot build up the way by a stopping, but have to place the doors to stop the passage of air; in many cases, the opening of a door to allow a person or horse and train of cars to pass, has a bad effect, by allowing the air to pass through it even for so short a time, and to avoid this evil, two doors ought to be employed, so that one may always be closed when the other is open; and the neglect of keeping doors shut has, no doubt, often led to serious explosions of gas in mines.

In some cases, it is necessary that the route of one split or current of air, should intersect and cross that of another, and in such cases one current is carried over the other; this arrangement is called an air crossing or bridge.

We have some of our well ventilated mines in Ohio, that in several places through the mines, they

air, and one of the most complete splits that I have seen is No. 8 shaft at Corning owned and operated by the Sunday Creek Coal Co. and superintended by Thomas Spence. The current is split in one place. In measuring the current just before we come to the split, we get twenty-eight thousand cubic feet of air propelling; after the split is made, we get fourteen thousand one hundred and fifty cubic feet propelling through one part, and thirteen thousand eight hundred and fifty in the other part, showing by actual measurement how accurate those splits can be made, everything corresponding. But there are other things right here we must consider, that is different lengths and different resistances. We sometimes find that too little air goes into the longer splits, compared with the quantity going into the shorter ones, and in order to correct this evil, we have to put regulators or contractors into the shorter ones so as to increase the natural resistance they offer and cause more air to go into the long splits. Regulators, although useful where they are unavoidable, are not desirable, as they contract the air-ways and so lessen the quantity of air circulating in the mine in a given time. As far as may be the routes of the air should be so proportioned that each split may obtain its proper share of air without using any artificial regulators, doors or air-crossings; and regulators should be avoided in all cases where the circumstances of the mine admit it; and I believe the day will come, and probably it is near at hand, when splitting air in mines can and will be done without doors or regulators.

Where furnaces are used to produce ventilation, the deeper the up-cast shaft the better, because this gives rise to a longer up column of hot air.

In calculating the velocity and quantity of the air current, the first thing it is necessary to know is the rule for ascertaining the quantity required for the complete combustion of the principle form of fuel; and it will be noted that the method of proceeding to arrive at the result must be taken as the rule to follow in all other calculations of a similar nature. The laws of inorganic chemistry will be found to apply here, and a careful perusal of the laws of chemical combination and affinity enable us to arrive at a result with comparatively little labor. In the first place, the combination of any two substances is simply their oxidation with the evolution of heat and, frequently, light; such products as are compound products—for instance, coal—cannot be entirely oxidized, that is, their combustion is not complete, and the residue is found in partially consumed particles; this we see in the smoke evolved from a furnace, and it may be taken as a general rule that the more complete the combustion, the less the smoke.

There is no destruction of matter or loss of weight in combustion. For instance, a candle is lit and burned out; a small quantity of ash on the end of the wick is all that remains to the naked eye, yet the candle is not destroyed; the ingredients of the candle have combined in certain proportions with the oxygen and æriform products, viz aqueous vapor and carbonic anhydride, weighing really more than the original candle.

This gain in weight represents the exact quantity of oxygen absorbed and used in bringing about the combustion of the candle, and it would be found that the decrease in weight of a volume of air sufficient to support the entire combustion of the candle, would be exactly equal to the increase of weight of the remaining products of the candle after combustion.

We find there are four laws that govern the combination of chemical substances.

First, when one body combines with another in several proportions, the higher proportions are the multiples of the first or lowest. Thus: Oxygen and hydrogen are contained in water in the following proportions: 16 parts of oxygen and 2 of hydrogen. The elements unite to form water. Here the proportion of oxygen is 32 to 2 parts of hydrogen.

Second, the same substance always consists of the same elements united in the same proportion.

Third, if two bodies combine with the third body, they are multiples of the proportions in which they may combine with each other. Thus: Carbon unites with oxygen in the proportion of 12 parts by weight of the former to 16 of the latter; hydrogen unites with oxygen, as already shown, in the proportion of 2 to 16. Fire-damp is a compound of carbon and hydrogen. Here 12 parts carbon are united to 4, or  $2 \times 2$  parts of hydrogen.

Fourth, the combining proportion of a compound is the sum of the combining proportions of its constituents. This sulphur peroxide is a combination of sulphur and oxygen in the proportions of 32 to

48, the sum of which is 80; water, of hydrogen and oxygen in the proportions of 2 to 16; the sum of the latter numbers is 18. When sulphur peroxide is added to water it unites in the proportion of 80 parts of the former to 18 of the latter. These laws will enable us to calculate all question relating to combustion.

In ventilating a mine, therefore, we have to take into consideration all substances in the mine that will require oxidation, such as the human beings, or rather the human blood, that of the horses or mules, the flames of the lamps, the delution of the gasses and the powder smoke. These items are the causes that draw on the ventilating current chemically; added to this we shall find that we have causes that effect the volume and velocity of the current mechanically. They are both the most important features in ventilation. Neglect of these two features has caused the most disastrous explosions, and the only way to provide against their recurrence, is thoroughly to master the scientific laws which govern the former item and the mechanical and practical causes which effect the latter. Having done this, provisions must be made for their joint demand, and they both must be provided for in estimating the velocity and volume of the ventilating current. The means for producing the current must then be determined on. But the first effective power, whether of the furnace or a fan, as the case may be, must be decided on, on the basis of a formula to arrive at the required result.